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Science and Art Gossip.

A FRAGMENT of the great comet was seen by Mr. W. R. Brooks, of New York, which after a few days faded out of view. Prof. Schmidt's small comet, another fragment, apparently, of the great comet, has also disappeared, as well as other cometary masses seemingly thrown off from the great comet, or perhaps driven away during perihelion passage.

SPEAKING of invention, the *Operator* says:—"Above all, patience is needed. There are probably one hundred disappointments to one success, and the things that are valuable seem very hard to do. 'When I was at Menlo Park,' says Mr. Edison, 'I was once working with my assistants a long time trying to connect a piece of carbon to a wire; every time it would break. Then we would spend several hours in making another, and that would break. After working a day and two nights in this way, we finally accomplished our purpose. One of my assistants wearily got up and said:—'Well, I think Job got too much reputation on a small capital!'"

IT is noteworthy that some of the most brilliant recent practical applications of electricity have been simply the development, by experiment and study, of familiar and apparently insignificant effects. Every telegraph operator has been familiar, ever since there has been a telegraph, with the phenomenon of the electric spark, and with the fact that a strong current will heat a conductor of high resistance; yet the electric-arc lamp is simply a development of the former and the incandescent lamp of the latter phenomenon. In the same way, the "polarisation" of batteries was known to telegraphists for years, and was regarded by them simply as an impediment to be got rid of; but the Planté and Faure accumulators are only developments of the same principle of "polarisation."

AN animated correspondence is proceeding in the *Railroad Gazette* (New York, Nov. 3) as to the comparative consumption of coal in American and English locomotives. The general result seems to be that the consumption in the former is much larger. One correspondent reckons it at double the amount, and accounts for it by three considerations:—1. That the loss by friction on curves is greater in America; 2, that inclines are more frequent; 3, that the entire heating surface of an American engine is of iron, the conductivity of which is greatly inferior to that of the copper or brass used in England.

THE same paper contains the official report of the fourth meeting of the Association of American Railroad Superintendents, at which a uniform code of train signals—by engine whistle, gong, and lamp, hat, or hand—was adopted, and recommended to the members.

AMONG the numerous substitutes for cod-liver oil which have from time to time been brought before the notice of the profession, dugong oil, which is an extract obtained from the dugong, an herbivorous cetacean inhabiting the warm seas of the coasts of Australia and the Eastern Archipelago, has met with a most favourable reception. Dugong oil is free from the unpleasant odour and taste which characterise cod-liver oil, and is much less liable to change in keeping. At ordinary temperatures it is opaque from the separation of its more crystalline constituents, but becomes clear and almost colourless when slightly warmed. The dose is the same as of cod-liver oil.

DR. MCCOLGANAN, in the *Southern Practitioner*, extols the value of the ether or rhigolene spray for the instantaneous relief principally of facial neuralgia. He first had occasion to observe its good effects upon his own person, he having suffered greatly from facial neuralgia. Since curing himself, he has had occasion to test its efficacy in about twenty cases. The result was invariably a most gratifying success. In many instances a permanent cure was established. He attempts to explain its action by supposing a complete change to take place in the nutrition of the affected nerve in consequence of the intense cold acting as a revulsive.

THE *Iron Age* (New York, November 9) says that Dr. Fritzgärtner, geologist and mineralogist to the Government of Honduras, reports that whole mountains of fine magnetic iron exist in Honduras, both near the coast and in the interior. The natives use clean fine ore directly in the forges; the iron produced is of superior quality, greatly resembling steel in all its characteristics. Semi-bituminous coal is very abundant along the Atlantic coast, and will before long become a valuable article of commerce along the Caribbean coast. It is said that the Government is so anxious to encourage the development of the industry that it will do all in its power to facilitate the transport of machinery, and will admit it free of duty.

THE Board of Trade have issued a new or revised scale for the wire gauges, and plainly intimate that unless very great opposition is offered, the Board will advise its adoption. The new scale is a compromise; it makes concessions to the thick-wire manufacturers, and takes an average of the Birmingham and Yorkshire gauges for the thinner sizes.

CHEAP brandy and absinthe are the cause of a large proportion of cases of insanity in parts of France. The United States Consul at La Rochelle, in his report on French brandies, points out the fact that no pure brandy is now made in Cognac and the district adjacent. He says

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that German alcohol, distilled from potatoes, is imported, doctored, and sold for brandy, and that the French artisans and peasants, who formerly used light wines, have of late years used much of this so-called brandy. He says, "Its characteristic effect is to produce an intoxication in which the patient is especially inclined to rage and physical violence, while hopeless insanity is the inevitable consequence of persisting in its use, even for a relatively short period of time." It is at least worth the physician's while to know that there is no such thing as pure Cognac now.

French Underground Telegraphy.—A subterranean telegraph cable is now being laid between Paris and the South of France, so as to place the French capital in direct subterranean communication with Marseilles. Two hundred and fifty workmen are now engaged in laying the cable, which follows as closely as possible the national roads on the right bank of the Rhône. The cable is laid in iron pipes at a depth of 5 ft. 6 in. The joints of the pipes are covered with caoutchouc, and every 1,666 ft. subterranean chambers are established so as to facilitate repairs.—*Engineering.*

An International Electrical Exhibition is to be held at Vienna in August, September, and October, 1883. No charge is made for space, nor for motive-power for the general illumination, and no prizes are to be awarded. Exhibits not patented will be protected until the end of the year.

One or two who cannot understand that wrong may offend *as* wrong, have assumed that our just indignation at the Kew Gardens wrong-doings must have been aroused by some personal grievance; and one "weekly" assumes that because the Editor of Knowledge chances to reside at Kew, his wrath has been aroused for that he cannot overlook the grounds from his parlour windows. To all this we reply that we have never had any personal relations, good, bad, or indifferent, with the present Director (if he should not rather be described as the wrongful proprietor) of the Botanic Gardens; that we neither know him personally, nor any one who (so far as we know) does so; and that half-a-dozen houses would have to be pulled down before even the great wall of the Gardens would be visible from our parlour windows. A manifest wrong is done to the public, Sir J. Hooker's paymasters; that is sufficient reason for the indignation which is felt by every honest man who knows the facts.

To see crowds along our streets, at night, with no brighter spectacle attracting them than the half-seen preparations for a street procession, staring intently at impressive inscriptions announcing welcome to royalty at "five shillings per head, ten shillings for front seats," and struggling to get a view of the draggled ends of cheap flags, suggests somewhat sad thoughts as to the worth of life to many. If there had been gladness of soul among the crowd one might have rejoiced to see how easily the many were pleased. But with the rush to see nothing, there was an air of gloom and disgust; and the favourite comments were oaths and foul language. A significant and depressing sight! To what proportion of our people, or of any people, even in these days of advanced civilization, has life aught of beauty and brightness? One feels half ashamed to enjoy the charm given by art and literature (and science, too) to life, after seeing how many, even in a single city street, there are who know naught of what makes life so valuable to the few.

It is asserted that in the three years ended 1880 there were no fewer than 252 theatres destroyed by fire, or partly so, resulting in 4,370 deaths, and about 3,400 injuries.

We give again this week the path of the comet during December. Fortunately during the past week the comet has not been favourably visible, so that an error of 20 m. in right ascension *throughout* in our last map can have done very little harm. The Editor was obliged to entrust the drawing of the path to another, being absent on a lecturing tour; and misunderstood instructions led to what might have been a rather troublesome mistake. (There was not time for a proof of the picture to reach the Editor, even had he been in town sooner.) The opportunity is favourable for noting what, we think, many readers seem not to understand. The Editor has other avocations, which, so far as he is personally concerned, are of many times greater importance than his work with Knowledge. It is a pleasure to him to give his time freely (practically a free gift) to cónverse with the readers of this magazine; but those other avocations cannot be always neglected. Occasionally it is only by a very hard struggle indeed that time can be *made* (there is no other word for it) for Knowledge; and for each of our many valued correspondents there are at least ten who simply waste the time thus with difficulty made available for editorial work. If some errors have to be corrected, it is not wonderful.

A point to be observed is that they *are* corrected and noted *here*, as carefully as if they were errors in some rival publication (if such there be). Yet often they have been occasioned solely by waste of time in searching through immense chaff-heaps for scattered grains.

The work involved in correspondence may be inferred from the five-and-a-half columns of Answers last week. This *must* be cut down, as, even if there were time for the work, there is not space, without exceeding the limits which, at our present price, can be afforded. We are thinking of closing the "Answers to Correspondents'" section, as the only effective way of meeting a difficulty which threatens the very existence of Knowledge (though really giving evidence of its success). Probably that will be the better way; but for the present we content ourselves with the appointment of a rigid censor of letters (who will not allow the editor even to *see* most of them), and the limitation of the "Answers" to a single column.

We give this week the opening paper of a series by Mr. Grant Allen, to be called the "Naturalist's Year." It will be continued weekly till the end of the year, afterwards fortnightly. The Christmas number of the series will deal with "The Mistletoe Bough."

The first paper of Prof. Wilson's series will be given next week, subject "Our Bones," illustrated. The series will alternate with Mr. Grant Allen's.

The Editor is having rather a busy time lecturing, at present. On Tuesday, Dec. 5, at Manchester in the afternoon, Bowdon in the evening; on Wednesday, Edinburgh; on Thursday, Falkirk; Friday, Galashiels; Saturday, Bonnybrook; Sunday, Glasgow; Monday (Dec. 11), Manchester; Tuesday, Hull, &c. This is more like his American and Australasian style of doing lecture work.

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DR. HENRY DRAPER.

BUT a few short months ago we had to record the death of Dr. J. W. Draper, in the fulness of age, and after a life devoted to scientific, literary, and professional labours. We had it in our thoughts then that he left behind him three sons, all students of science, and one already so distinguished that there was every reason to regard him as following as closely in his father's footsteps as John in the footsteps of William Herschel. But those hopes must remain unfulfilled, and science must rest content with the good work which the young Draper was able to complete in the short space of life allotted to him.

Born in Virginia, on March 7, 1837—the son of an English father and a Spanish mother—Henry Draper was brought up in New York, and would have been recognised as a Northern American by all familiar with the diversities of type co-existing in the United States. He graduated in 1858 at New York University, where his father was Professor of Chemistry; and in 1860 he was elected to a professorship there. In 1866 he became Professor of Physiology in the Medical Department.

Dr. Draper's achievements in science have nearly all been associated with the application of photography to the increase of our knowledge. He, more, perhaps, than any man in our time, has shown the power of the photographic eyes of science. Thus, in 1857, he used microscopic photography to aid in a series of researches into the function of the spleen. He next became famous for his labours in celestial photography, making, *inter alia*, a remarkably fine photograph of the moon (which hangs before us as we write), with a 15½-inch reflecting telescope of his own construction. Later, he made a fine reflecting telescope of 2⅓ feet in aperture, the speculum being of silvered glass. With this, in 1872, he attempted the then most arduous task of photographing the spectra of the stars. Later, using the sensitive gelatine plates, he achieved a marked success in this still difficult work. He brought the spectra of the stars into direct comparison with the spectrum of our own star, the sun, using as reflecting adjuncts to his telescope the planets Jupiter and Venus, to give the solar spectrum with sufficiently reduced light. His photograph of the diffraction spectrum in 1872—from near the G line to line O in the invisible part beyond the violet—has justly been regarded as one of his most successful achievements.

In 1874, Dr. Draper's reputation in celestial photography led to his being appointed Superintendent of the Photographic Department of the American Venus-Transit Commission; and he worked so successfully and disinterestedly in the discharge of the duties thus entrusted to him, that the United States Government did honour to themselves by causing a special gold medal to be struck at the Philadelphia Mint, bearing the motto, "*Decori Decus Addit Avito*,"* in which his father's fame is worthily linked with his own. In 1877, Dr. Draper undertook a long journey to the Rocky Mountains, to experiment on the effects of the greater steadiness and clearness of the air at an elevation of 11,000 feet above the sea-level. He led a party the following year to the same region to observe the total eclipse of July, 1878, and succeeded in photographing the diffraction spectrum of the corona.

During the autumn and winter of 1880-81 he photographed the nebula in Orion. Our contemporary *Nature* says "last autumn and winter" he took such photographs, which "were the first he ever made;" but this is an error: in April, 1881, we had the pleasure of examining in his laboratory the first one-inch negatives he had obtained, showing a marvellous amount of detail in the nebula, closely resembling what is shown in the drawings made by Trouvelot at the Washington Observatory, and later—in May, 1881—we saw the improved positives (much enlarged) of the Great Nebula. Of these, which had been then recently completed, one lies before us as we write, bearing the date on which it was presented to us, "May 16, 1881." Later he applied photography to the more difficult and delicate task of recording the spectrum of the nebula in different parts, and he also photographed the Spectrum of Wells' Comet.

But the work with which his name will chiefly be associated is that which for this reason we have left to the last, his recognition—still by aid of celestial photography—of the existence of oxygen, and probably nitrogen also, in the sun. Of the ingenious methods by which he mastered the difficulties in the solution of the problem of comparing the spectrum of our air with that of the sun, we need not speak here. They would occupy, indeed, much space; but they have been already fully described by us elsewhere. Suffice it, that the result satisfied all save a very few—whose opinion was perhaps biassed—that oxygen is present in the solar atmosphere in such a condition that, emitting more light than it absorbs, it makes its presence known by bright lines.

The loss sustained by science in the early death of so honest and zealous a worker is that which we must chiefly consider here. But it is impossible for those who knew Dr. Draper personally to omit some reference to his qualities as a man. Kindly, genial, and bright, he was a living contradiction to the common idea that the ardent student of science must be a man of worn and gloomy aspect, serious, if not morose, in disposition, uncheerful in temperament. He spoke of the results of patient, long-continued toil, as a boy might talk of a trophy won at cricket or base-ball. He passed lightly over the wrongheadedness of envious (because less successful) workers in his field of labour. Blessed with the companionship of a wife who shared his aspirations, encouraged his labours, rejoiced over his successes, and sympathised when less complete success than he had hoped for rewarded him, he pursued his work earnestly and zealously. With that lady, all who know her and knew her husband's worth will warmly sympathise. We sorrow ourselves in the loss of a most valued friend, with whom we had hoped to foregather again before many months were past, and for years, if life had been granted us, to have heard in his own country (our home before long), and from his own lips, the recital of his hopes and fears, his partial failures and his final triumphs. Of the same age as himself, within sixteen days, and recognising in him, as we thought, a man of enduring constitution, we should have hoped for him a longer space than for ourself by many years. But it was not to be, and science has to mourn the premature death of one of the most faithful of her servants.

* He adds renown to fame inherited.

AERIAL NAVIGATION.—M. De Comberousse, in a discourse pronounced at the funeral of the late Henri Giffard, made this significant admission:—"An intimate friend of Giffard told me yesterday that he carried to the tomb the secret which he had long sought for, and which had revealed itself to his eyes during his last years. He added that our colleague shrank back from his own discovery, and, filled with horror, put an end to his existence." In other words, he saw at length that aerial navigation must prove the suicide of civilisation.

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A NATURALIST'S YEAR.

I.—AUTUMN BUDS.

By Grant Allen.

HOW full of promise for the coming season is this little forked spray of hawthorn, which I have picked from the hedgerow, already thickly covered with the buds and leaves of next spring's foliage. In a certain sense, indeed, one may fairly say that the naturalist's year begins most truly in late autumn. It is then that many of the animal life-cycles start on their appointed course; it is then that next year's seeds are sown, that next year's leaves are rudely formed, that next year's eggs are buried securely in the sheltering ground. Take, for example, the case of foliage and flowers. To the casual observer, it seems as though these most notable of all external objects, which clothe the trees and the fields throughout the whole summer, began their yearly course with the first return of spring. In reality, however, many or most of them have lived on in embryo forms from the preceding autumn. This is the case even with annual seedlings; for if you cut open a seed, you will find that it consists of either one or two seed-leaves (according as it belongs to one or other of the two great flowering stocks), and these seed-leaves, with their enclosed bud, are already perfect in the ripe fruit, although they do not expand and develop their feathery head until the spring comes with its warmth and moisture to continue the arrested cycle of their growth. With some precocious plants, indeed, the young seedlings habitually sprout in great numbers during the autumn, struggle on somehow through the cold season, and start afresh with redoubled vigour in March or April. This is especially the case this year in England with the little goosegrass or cleavers, which is now growing abundantly in every hedgerow here, and is struggling among the brambles and briars as if it meant to hold its own bravely till the frosts are over.

But what is true of the annuals to a certain extent is far more deeply and universally true of perennials, like this bit of hawthorn. In all trees, for example, the buds which represent the future branches for next year's growth are produced and elaborated in the preceding autumn. As the dead leaves fall off in October, the living chlorophyll and protoplasm which formed their active functional parts are withdrawn into the permanent tissues of the tree; and their withdrawal, aided by various internal chemical changes, chiefly of the nature of oxidation, leaves the minor colouring matters of the foliage far more prominent than before, and so gives rise to that glow of crimson and gold which we commonly know as autumn tints. Then the protoplasm and the other vital principles go in part to form a reserve for next spring's growth, but in part also to produce the buds which are to live through the winter as visible symbols of the coming summer. Outside you see the buds are enveloped in dry brown scales, which make them very inconspicuous to the eyes of their enemies, who would otherwise quickly devour these rising hopes of the future season. Clearly, such brown protective coverings have been acquired by the buds through natural selection of the best concealing hues, and by natural destruction or eating off of all the greener or more noticeable buds. Sometimes, however, as in the familiar case of the horse-chestnut, the buds themselves are so large and visible that they cannot possibly be overlooked; and this difference everybody must have noticed for himself, since we very seldom observe the winter buds on hawthorns or elms, but we never fail to observe them on the horse-chestnut. Under these circumstances, the buds could never have escaped at all, if they did not possess some special and extra means of protection; and as a matter of fact we know that the embryo horse-chestnut leaves are protected by peculiarly gummy and resinous scales, which effectually ward off all insect or animal foes. Wherever we find very noticeable winter buds, indeed, we almost always find some such device for ensuring their survival, and in the few instances where we cannot detect any such device, it is safer to conclude that we have not yet fathomed all the tricks and chances of nature, than to conjecture hastily that no protective plan at all exists for their benefit. Tastes that are not nasty to us, may be very nasty to many a grub or caterpillar; leaves that seem scentless to us, may be unpleasantly pungent to the little smell-pits on the antennæ of many a flying insect hairs, and scales and glands that look utterly meaningless to our clumsy eyes, may prove fearful and deterrent enough to many a prowling beetle or weevil. Depend upon it, there never was a worse bit of philosophy invented (which is saying a good deal) than that famous Greek phrase of crystallised human vanity—"Man is the measure of all things."

The scales have another function to perform, however, besides that of keeping off unwelcome visitors from the young leaves. They act as great-coats or cloaks to cover the dormant living germs from the cold of winter. Everybody knows that frost kills plants; and everybody has noticed that if the foliage expands in spring too soon, it is very apt to get nipped off by a late return of morning rime. That suggests how much need the buds have for a close, warm covering. Indeed, Mr. Darwin has shown that leaves are astonishingly sensitive even to comparatively slight changes of temperature, and that the so-called sleep of leaves, and many other curious modes of motion in plants, are due to the necessity for protecting the foliage from nightly chills. Those delicate plants which, in the course of their spontaneous variations, happened to hit out any peculiarity tending towards self-preservation in this direction, have gone on and thrived; those which failed to do so have been cut off generation after generation by every colder night. Now, what is thus true of the vital matter in leaves generally, is especially true of the vital matter in very young and undeveloped leaves. It cannot resist the slightest frost. Hence natural selection has in the course of long ages ensured the best possible means for keeping the true inner bud warm and snug. If you pick off some of these small brown scales, you will see how closely they are packed together, overlapping one another in regular rows, or imbricated as the technical botanists call it. That is an unusually good word, imbricated, by way of scientific terminology; for it means, arranged like tiles on a roof; and in fact the scales do really lap over one another just like the Italian tiles that one sees on cottages in Southern Europe. These short, broad, brown, close-set scales are themselves by origin abortive leaves; or, to put it more truly, they are leaves which have given up their original function of digesting fresh material from the air, and have taken to the new function of protecting their more active sisters from the sharp teeth of the frost. Underneath the brown outer pieces, however, you come at last to some tiny bright green knobs; and these shapeless little things are the living parts which carry on the continuity of the bush from one season to another. As soon as spring sets in, they will be supplied with fresh living material from the reserve stores in the permanent tissues of the hawthorn, and they will then swell quickly within the brown covering, showing at first a little pinkish tip, and finally spreading out as thin, pale green leaves, full of very active chlorophyll—giving them the beautiful spring hue which we all love and admire so

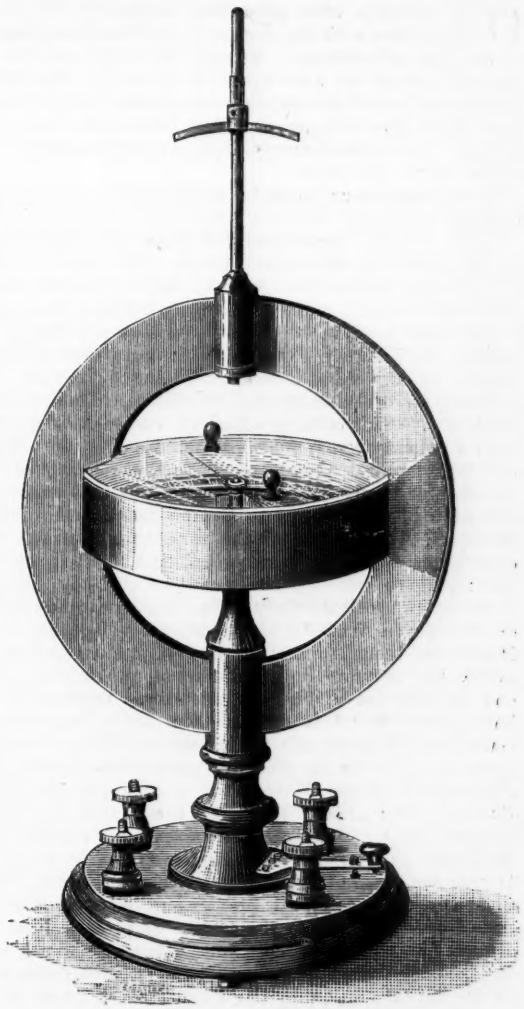
much in the first days of returning sunshine. Some trees carry this principle of provision for the future one step further, and lay up their flower buds as well as their leaf buds four months beforehand. For example, look at this little sprig which I have just picked from the overhanging alder. You see at once that it is covered by two kinds of buds, one of which clearly foreshadows the future foliage, while the others are just as distinctly unripe catkins. At the very first approach of warmer weather in earliest spring, the alder catkins burst out at once into full bloom, and so succeed in getting their tiny cone-like fruits well set by wind-fertilisation, long before even the willows and the elms have been duly impregnated by the honey-seeking bees.

THE AMATEUR ELECTRICIAN.*

ELECTRICAL MEASUREMENT.—VI.

HAVING described the more important units adopted in electrical measurements, it behoves us next to direct our attention to the apparatus employed in making such measurements. Of all the instruments used for this purpose, none are so generally adopted as the galvanometer. The ordinary form, consisting of a coil of wire surrounding a magnetised needle, which is deflected by the passage of a current through the coil, may, however, be more fitly described as a galvanoscope.

But "to obtain accurate results, we require accurate observations, made on accurate instruments, by accurate methods." The tangent galvanometer is an instrument which, if properly handled, is capable of recording most accurately, and as its construction is somewhat easy, a detailed description of it will doubtless be of some service. The illustration (for the use of which we are indebted to the courtesy of the proprietors of the *Electrical Review*), represents, with one or two little omissions, the tangent galvanometer used in the telegraph service. It is made chiefly of brass, but good *dry* wood, although, perhaps, less elegant, will answer the purpose quite as efficiently. In the base plate or block, $6\frac{1}{2}$ in. in diameter, are four brass terminals or binding-screws, and supported by a short stout pedestal is a flat ring, $1\frac{1}{2}$ in. wide, with an external diameter of 8 in. It is about $\frac{1}{4}$ in. thick, with a deep groove $\frac{1}{4}$ in. wide cut on the outer edge. In this groove several layers of No. 35 copper wire are wound, enough to offer a resistance of about 250 Ohms, the ends of the wire being attached to two of the above-mentioned binding-screws. Outside this fine wire a few layers of No. 16 wire are wound and connected to the other pair of binding-screws. Care must be taken that the insulating material is not rubbed off the wire, and it would be advisable to fill up the groove with some insulating substance. Where elegance or neatness is desired, it would be best to lead the wires, through the pedestal, to the base, and make the connection underneath. The needle-case is fixed across the centre of the vertical ring, and consists of a box about an inch deep inside, with a glass cover through which the needle can be seen. The needle is rather difficult for an amateur to make, and to secure efficiency it had better be placed in the hands of a competent workman. Essentially it consists of a small magnet about $\frac{3}{4}$ in. long, with a fine brass wire, or pointer, about $4\frac{3}{4}$ in. long attached to it at right angles, an agate pellet being fitted in a cap provided for it. The whole revolves on a fine steel point. The base of the box is graduated into degrees of a circle on one side of the ring, and into divisions proportional to the tangents of the angles on the other side. A stout brass wire fixed to the upper edge of the ring carries a sliding tube with a slightly curved "controlling" magnet. The tube fits "spring-tight," to prevent it falling from any portion of the wire to which it may be moved, the function of the magnet being to increase or decrease the sensitiveness of the needle in proportion as it is raised or lowered.



The little "key" seen between the binding screws on the right of the figure is used for short-circuiting the galvanometer, but it may be ignored by the amateur. Its use is to bring the needle to rest speedily. In setting the instrument to take a reading, it should be turned round until the pointer is over the zero of the scale, and at right angles with the vertical ring. The magnet and the ring will then be in the magnetic meridian. The principle upon which the instrument is constructed is explained in any good text-book. We may, however, say that the needle being very short in comparison to the diameter of the ring, the

* In "Measurement V.," on page 103, read ·1 for ·1·1, and ·08 for ·04; and on page 104 read $\frac{40}{\cdot 6+6}=6\ \cdot\dot{0}\dot{6}=\dot{1}\ \cdot 2\dot{1}$ for $\frac{40}{6+6}=6\ \cdot\dot{0}\dot{6}=1-212\cdot$

relative position of the needle and coil will be but slightly affected by a deflection of the former, and, consequently, the strength of the current will be in proportion to the tangent of the angle of deflection.

WAS RAMESES II. THE PHARAOH OF THE OPPRESSION?

By Amelia B. Edwards.

XIV.—TEL EL-MASKHUTA.

OUR difficulty when attempting to identify Tel Aboo-Sooleyman with the mound of Pa-Tûm is the absence of monumental evidence. No such difficulty confronts us, however, when we interrogate the mound of Maskhuta. Evidence of every description—monumental, documentary, local, direct, indirect, circumstantial, inferential—lies ready to hand. Our embarrassment, if we are embarrassed, is the embarrassment of wealth.

I will endeavour to state this evidence clearly and briefly.

First in order stands the fact that the neighbouring village preserves its ancient name. The name of the mound—the mere mound—would seem to have varied from time to time; or, more correctly perhaps, the mound would seem to have been equally well-known during the present half-century by some three or four different names—as Tel Aboo-Kesched, Tel Aboo-Kesheeb, Tel-el-Sakeeyah, Tel-el-Masroota, Mashoota, Mahuta, and Maskhuta. This multiplication of names, arising from local circumstances, is a common feature of modern Egyptian topography. Aboo Kesched, or Kesheeb, is "father" Kesched, or Kesheeb, and means probably that some holy man of that name elected to live on the mound. Tel el-Sakeeyah, "the mound of the water-wheel," shows that once upon a time a water-wheel was erected on the spot; and so on. In the same way, Wady Tûmilat is sometimes called Wady Seba Biar, or "the Valley of the Seven Wells." The inhabited village at Tel-el-Maskhuta, though a mere cluster of mud-huts, is at all events the genuine representative of the ancient city; and it is called *Ramsis* to this day. Lepsius, as we have seen,* found it so called in 1845; and in the last edition of Isambert's "Itineraire de l'Orient" (Guides Joanne), 1878 (the Egyptological parts edited by Mariette Pasha and Professor Maspero), it is expressly said, "*près du canal Abou Dibab*" (the New Freshwater Canal) "*se trouve Ramsis, qui rappelle évidemment une ancienne ville de Ramsès passée sous silence par les historiens profanes.*" ["near the Canal of Abou Dibab is found Ramsis, which evidently commemorates an ancient city of Rameses, passed over in silence by the writers of profane history."] I quote this passage to show that "Ramsis" is not, as it has generally been supposed, a merely fanciful name given to the railway station by the French constructors of the line; but that it is actually a Pharaonic survival.

The mound itself, described by the *Times* correspondent as "of considerable height and size" (see the *Times*, Aug. 25), is small in comparison with the mounds of Tanis, Memphis, Heliopolis, and other great capital cities. Its appearance, in fact, so disappointed Professor Sayce in 1880, that he doubted whether it was indeed the famous "treasure-city" of Pharaoh. But, as I then pointed out, in a letter to the *Academy*, a treasure-city, or *Bekhen*, was not necessarily a place of very great extent. The name is elastic, and may apply to a small enclosure or to a mighty stronghold. In its ordinary acceptation, it would seem to stand for a military storehouse and fort, where provisions and arms were kept for expeditions across the desert, and where booty might be deposited. The mound of Tel-el-Maskhoota is, at all events, more than large enough to cover the ruins of a very considerable fortress; and of that fortress, the massive wall of circuit may yet be traced. The bricks of which this wall is built are stamped, according to the testimony of Professor Ebers, with the name of Menephthah, the successor of Rameses II. The mound, which has never been excavated, is thickly strewn with fragments of granite and with immense quantities of pot-sherds; but the one relic which has chiefly made its reputation is a huge monolith, sculptured on the one side with a group of three figures, representing Rameses II. between the gods Ra and Tûm, and, on the other side, with the name of this Pharaoh in a royal oval, six times repeated. So long ago as the time of the first French expedition, this important monument was first discovered, and there it still lies; the last traveller to report upon it being Professor Sayce, in 1880. Till of late years it was the only work of art known to exist at Tel-el-Maskhuta; but in 1876, when the new Freshwater Canal was in course of excavation, M. Paponnet, chief engineer of the works, discovered under a bed of alluvial deposit, at a spot closely adjoining the mound, the remains of a paved causeway, or *dromos*, and two fine sphinxes engraved with the ovals of Rameses II. There can be no doubt that the causeway and the sphinxes formed part of the approach to a temple, and further excavations in that direction would in all probability lead to the discovery of an avenue bordered by sphinxes, and finally to the remains of the temple itself. Another, and a very interesting relic—which, however, is far from being unique—was brought from Tel-el-Maskhuta in 1845 by Dr. Lepsius, and by him presented to the Museum of Berlin. The relic in question is an enormous brick of sun-dried clay, measuring rather more than 17 in. long by 9½ in. wide, and nearly 5 in. thick. It is made of alluvial mud, from clay-beds found in the neighbourhood, mixed with chopped straw, and stamped with the oval of Rameses II. There are plenty of these bricks to be found in and about the mound; but they must not be confounded with the bricks of Menephthah more lately discovered by Professor Ebers in the wall of circuit. It is important that we bear this distinction in memory. If, however, the mound of Tel-el-Maskhuta be in truth the mound of "Raamses," then these bricks—the bricks of Menephthah, no less than the bricks of Rameses II.—were unquestionably made by the hands of the Hebrews in Goshen.

Finally, some four or five miles westward of Tel el-Maskhuta, going towards Tel-el-Kebeer, there lies to the south side of the Sweetwater Canal a large sheet of water called Lake Mahsamah.* This lake, which is utilised as a reservoir by the Canal Company, was formerly fed from the annual inundation of the Nile.

I must now ask those who have accompanied me in the present inquiry, to go back over some of the ground we first traversed, and to examine whether the mound of Maskhuta, in its position, its surroundings, and in regard of such few ancient remains as have been there discovered, or are yet visible upon the surface, answers more satisfactorily to the Pa-Rameses of the monuments and the "Raamses" of the Bible, than Tanis, Pelusium, Heliopolis, or any other site as yet proposed by Egyptologists.

(To be continued.)

* See Knowledge," vol. ii., pp. 260-261.

* See Map of Wady Tûmilat, vol. ii., p. 357.

HOW TO GET STRONG.

THE WAIST.

WE have given enough chest exercises to last our followers for months; but it is not well to limit exercise to any one portion of the trunk, as those do who pin their faith on rowing, or boxing, or tricyling, or running, or any other special kind of bodily training.

We come now to certain muscles which are usually very much neglected in this country, especially by the fairer, and in this respect certainly the weaker, sex. When we hear men talking of wearing stays, or find that they are even thinking of such an absurdity, we have in reality the clearest evidence that the abdominal muscles have been neglected. A man in decent condition should as soon think of taking to crutches as to corsets.

Weak abdominal muscles are readily detected in walking. If a sense of distress across the abdomen and around the loins is felt after moderate walking exercise, especially after a slow walk, if the shoulders begin to hang forward, or the trunk lean forward from the hips, we may be sure that the waist muscles want attending to. This also shows that walking affords them exercise. But it is not the best exercise for them.

Wearing a corset, or shoulder-straps, or a backboard, will prevent you from feeling this sense of distress about the waist. So will lying on your back all the time. If you like, you can adopt these measures. In that case we are writing, not for you, but for others not quite so lazy or so unwise.

Taking, first, walking exercise, directed to the special purpose of strengthening the abdominal muscles, observe that a long wearisome walk will do more harm than good in the long run. Take a sharp, steady two-mile walk, at not less than three and a half miles an hour, and not more than four; keep the head up, shoulders well back, the body erect, the abdomen slightly forward, but not enough to hollow the back. Half a mile walked in this way will do more good than four or five miles at a dragging pace. The heart and lungs have good space to act in, and you presently find that they do act, and with energy. It is in maintaining this attitude that the muscles around the waist are exercised.

In running, which ought to be a daily exercise with all men in good health (though, as we have said, not suddenly or rashly begun, but moderately), the waist muscles are called into play if the style of running is well chosen—shoulders held well back, body upright, and strides long and energetic.

Turn now to indoor exercise for the waist.

Here is one which will very quickly harden the abdominal muscles. Sit on a bed with the toes hitched under the cross-bar of the foot-board (you can pad the bar if it hurts your instep at all), so that when you lie back your head falls on the pillow. (Pitch the pillow out, however.) Sway the trunk steadily backward till you are lying in a horizontal position. Then steadily draw it upwards again, and sway it over till the shoulders are well over the knees, keeping the trunk straight throughout both movements. Draw in the breath as you sway backward, and expel the breath as you sway forward—doing each to the full extent of your lungs. Thus you combine good chest exercise with excellent work for the waist muscles. The exercise need not, of course, be taken on a bed. You can sit on the floor with the feet held by a strap, or by the lower part of a sufficiently solid and heavy piece of furniture (be very careful on this point). Or in pleasant weather you can take this exercise in the open air,—as indeed most of the exercises suitable for waist strengthening.

Here follow two forms of exercise which are recommended by Blaikie. They *can* be taken in the open air, but most would prefer to limit their use to indoors, especially the first one:—(1.) Lie flat on the back. Taking first a deep, full breath, draw the feet upward, keeping the legs straight and close together, until the legs are vertical. Lower them *slowly* till horizontal, then raise and repeat, till you find you would much rather stop. (2.) Keep the legs down, and first filling the chest, draw the body up, keeping the trunk quite straight, till you are erect. Then sway slowly back; repeat as often as you find it convenient. You need not go on for half-an-hour, or even a quarter, unless you like. With practice you will find that you can not only do this pretty often, but lift a heavy weight along with you.

(*To be continued.*)

THE ATMOSPHERE OF SPACE.

ON the last lines of p. 399, Mr. Proctor says that M. Faye's calculation of the quantity of inter-planetary air that the sun would collect around himself under the conditions stated by Dr. Siemens, "forces us to reject absolutely and decisively such an atmosphere as Dr. Siemens and Mr. W. M. Williams have imagined." This forces me to reject absolutely and decisively such a bracketing of my imagining with that of Dr. Siemens.

The atmosphere which I have imagined is simply and exclusively that which would remain after all the solar accumulation to which M. Faye alludes is completed. I start at the very outset with the assumption that this has been done not only by our sun, but also by every other orb in space.

The density of this residuum of inter-planetary and interstellar atmosphere depends upon its inherent gaseous elasticity, and this elasticity is the material manifestation of heat. If no heat were radiated into space, it would be the vacuum imagined by the astronomers who are "enjoying the joke" of an universal atmosphere; but neither their amusement nor their formulating can disprove the necessity of the universal extension of atmosphere matter into all space that is receiving solar, stellar, and planetary radiation, unless they can prove that the laws of Nature cease to operate at the limits which they assign to our terrestrial atmosphere.

W. Mattieu Williams.

TRANSITS OF VENUS.

By Richard A. Proctor.

(*Continued from page* 419.)

I SHALL next show how Halley and Delisle contrived two simple plans to avoid the manifest difficulty of carrying out in a direct manner the simultaneous observations, described at p. 418, from stations thousands of miles apart.

We have seen that the determination of the sun's distance by observing Venus on the sun's face would be a matter of perfect simplicity if we could be quite sure that two observations were correctly made, and at exactly the same moment, by astronomers stationed one far to the north, the other far to the south.

The former would see Venus as at A, Fig. 6, the other would see her as at B; and the distance between the two

XUM

lines *a a'* and *b b'*, along which her centre is travelling, as watched by these two observers, is known quite certainly to be 18,000 miles, if the observers' stations are 7,000 miles apart in a north-and-south direction (measured in a straight line). Thence the diameter, S S', of the sun is determined, because it is observed that the known distance, *a b*, is such and such a part of it. And the real diameter in miles being known, the distance must be 107 times as great, because the sun looks as large as any globe would look which is removed to a distance exceeding its own diameter (great or small) 107 times.

But unfortunately it is no easy matter to get the distance, *a b*, Fig. 6, determined in this simple manner. The distance, 18,000 miles, is known; but the difficulty is to determine what proportion the distance bears to the diameter of the sun, S S'. All that we have heard about Halley's method and Delisle's method relates only to the contrivances devised by astronomers to get over this difficulty, It is manifest that the difficulty is very great.

Fig. 6.

Fig. 7.

For, first, the observers would be several thousand miles apart. How, then, are they to ensure that their observations shall be made simultaneously? Again, the distance *a b* is really a very minute quantity, and a very slight mistake in observation would cause a very great mistake in the measurement of the sun's distance. Accordingly, Halley devised a plan by which one observer in the north (or as at A, Fig. 5) would watch Venus as she traversed the sun's face along a lower path, as *a a'*, Fig. 7; while another in the south (or as at B, Fig. 5) would watch her as she traversed a higher path, as *b b'*, Fig. 7. By timing her they could tell how long these paths were, and therefore how placed on the sun's face, as in Fig. 7; that is, how far apart, which is the same thing as determining *b a*, Fig. 6. This was Halley's plan, and as it requires that the duration of the transit should be timed, it is called the method of durations. Delisle proposed another method—viz., that one observer should time the exact moment when Venus, seen from one station, *began* to traverse the path *a a'*, while another should time the exact moment when she *began* to traverse the path *b b'*; this would show how much *b* is in advance of *a*, and thence the position of the two paths can be determined. *Or* two observers might note the *end* of the transit, thus finding how much *a'* is in advance of *b'*. This is Delisle's method, and it has this advantage over Halley's—that an observer is only required to see *either* the beginning or the end of the transit, not *both*.

I shall not here consider, except in a general way, the various astronomical conditions which affect the application of these two methods. Of course, all the time that a transit lasts, the earth is turning on her axis; and as a transit may last as long as eight hours, and generally lasts from four to six hours, it is clear that the face of the earth turned towards the sun must change considerably between the beginning and end of a transit. So that Halley's method, which requires that the whole duration of a transit should be seen, is hampered with the difficulty arising from the fact that a station exceedingly well placed for observing the beginning of the transit might be very ill placed for observing the end, and *vice versâ*.

Delisle's method is free from this objection, because an observer has only to note the beginning *or* the end, not both. But it is hampered by another. Two observers who employ Halley's method have each of them only to consider how long the passage of Venus across the sun's face *lasts*; and they are so free from all occasion to know the exact time *at* which the transit begins and ends, that theoretically each observer might use such an instrument as a stop-watch, setting it going (right or wrong as to the time it showed) when the transit began, and stopping it when the transit was over. But for Delisle's method this rough-and-ready method would not serve. The two observers have to compare the two moments at which they severally saw the transit begin—and to do this, being many thousand miles apart, they must know the exact time. Suppose they each had a chronometer which had originally been set to Greenwich time, and which, being excellently constructed and carefully watched, might be trusted to show exact Greenwich time, even though several months had elapsed since it was set. Then all the requirements of the method would be quite as well satisfied as those of the other method would be, if the stop-watches just spoken of went at a perfectly true rate during the hours that the transit lasted. But it is one thing to construct a time-measure which will not lose or gain a few seconds in a few hours, and quite another to construct one which will not lose or gain a few seconds in a journey of many thousand miles, followed, perhaps, by two or three months' stay at the selected station. An error of five seconds would be perfectly fatal in applying Delisle's method, and no chronometer could be trusted under the conditions described to show true time within ten or twelve seconds. Hence astronomers had to provide for other methods of getting true time (say Greenwich time) than the use of chronometers; and on the accuracy of these astronomical methods of getting true time depended the successful use of Delisle's method.

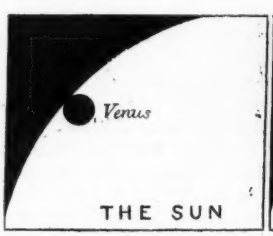


Fig. 8.

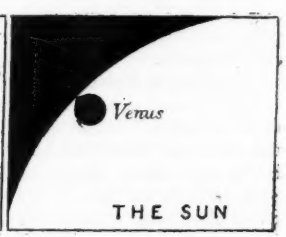


Fig. 9.

Then another difficulty had to be considered, which affected both methods. It was agreed by both Halley and Delisle that the proper moment to time the beginning or end of transit was the instant when Venus was just within the sun's disc, as in Fig. 8, either having just completed her entry, or being just about to begin to pass off the sun's face. If at this moment Venus presented a neatly-defined round disc, exactly touching the edge of the sun, also neatly defined, this plan would be perfect. At the very instant when the contact ceased at the entry of Venus, the sun's light would break through between the

edges of the two discs, and the observer would only have to note that instant; while, when Venus was leaving the sun, he would only have to notice the instant when the fine thread of light was suddenly divided by a dark point. But unfortunately Venus does not behave in this way—at least, not always. With a very powerful and very excellent telescope, in perfectly calm, clear weather, and with the sun high above the horizon, she probably behaves much as Halley and Delisle expected. But under less favourable conditions, she presents at the moment of entry or exit some such appearance as is shown in Figs. 9 and 10, while with a very low sun she assumes all sorts of shapes, continually changing, being for one moment, perhaps, as in one or other of Figs. 9 or 10, and in the next distorted into some such pleasing shape as is pictured in Fig. 11.

Fig. 10. Fig. 11.

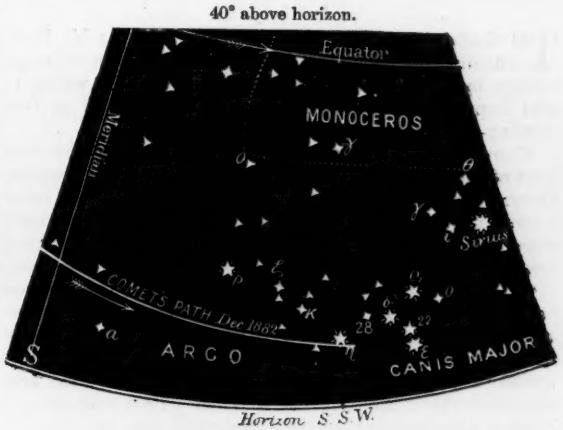
Accordingly, many astronomers are disposed to regard both Halley's method and Delisle's as obsolete, and to place reliance on the simple method of direct observation first described. They would, however, of course, bring to their aid all the ingenious devices of modern astronomical observation in order to overcome the difficulties inherent in that method. One of the contrivances naturally suggested to meet such difficulties is to photograph the sun with Venus upon his face. The American astronomers, in particular, consider that the photographic results obtained during the transit of 1874 will outweigh those obtained by all the other methods. European astronomers failed so thoroughly with this method in 1874 that they place no reliance on it whatsoever.

COMET'S PATH.

WE have to give this week the comet's path (both pictures) again, a strange mistake (though easily explained) having crept into the maps given last week. The path, deduced from Chandler's estimates was, through a misunderstood instruction from the Editor, who was away from town, thrown twenty minutes eastward, and thus a much more marked discrepancy than actually exists between Mr. Hind's and Prof. Chandler's results was made to appear staringly on the maps. Those now given are correct. The dates from the small map are as follows :—

December 8, at 4 a.m.	December 27, at 2·45 a.m.
„ 12 „ 3·45 a.m.	„ 31 „ 2·30 „
„ 16 „ 3·30 „	January 3 „ 2·15 „
„ 19 „ 3·15 „	„ 7 „ 2·0 „
„ 23 „ 3·0 „	&c., &c.

Erratum.—Dollond's 3-inch "Student's" Telescope.—We beg to correct the following compositor's error which appeared in your last issue under the heading of "Extracts from letters respecting the Student's Telescope," namely:—"3. With power 160, ζ Ursæ Majoris" should have been "ξ Ursæ Majoris."—The latter is a difficult test, while the former is an easy one, and may mislead.—Dollond & Co.



DR. SIEMENS' SUN THEORY.*

By M. Hirn.

TO that most serious objection presented by M. Faye against the new theory of the conservation of solar energy by Mr. Siemens, another may be added, which is also important. This objection can be presented in few words :—

There is no agreement at present respecting the real heat of the sun. Fr. Secchi raised it to millions of degrees. Other physicists, especially in France, lowered it to some twenty thousand degrees. According to the magnificent experiments of Mr. Langley (Alleghany) the last-mentioned is in any case a minimum. What is thence certain, if we take as our basis the fine labours of our regretted *confrère*, Henri St. Clair Deville, on dissociation, is that none of the chemical compounds known to us on earth can exist on the surface of the sun. All, even those most stubborn in our laboratories, would be dissociated and reduced to their constituent elements. This, moreover, is what is admitted in the actual theory of the sun adopted by M. Faye.

The natural and direct consequence of this fact is that the chemical compounds which Mr. Siemens supposes to be dissociated gradually in space by solar radiation, might well, in returning in the elementary state under the action of gravity towards the central sun, restore and regenerate the heat employed in dissociating them in space ; but this recombination could only be produced at a considerable distance from the solar photosphere ; and the compounds thus formed, in falling on the surface of this, would be completely dissociated afresh. This act would, therefore, use up all the heat before developed in the process of combination. It follows evidently from this that the return of the elements towards the centre would be of no avail towards the conservation, or rather towards the continual reproduction, of the solar temperature.

It seems to me that Mr. Siemens' theory can be subjected to another decisive critical test. [What follows is one of the disproofs of Dr. Siemens' theory, which I have given in my article on "The Sun as a Perpetual Machine," in the *Cornhill Magazine* for May or June last; but M. Hirn's mode of presenting it is neat and effective.—R. A. P.]

If the solar radiation—let us say the heat, visible or invisible—emitted or returned by any star effects in its progress the chemical dissociation of the hypothetical compounds disseminated in interstellar space, the intensity of this radiation should necessarily be reduced by the actual work done, and all which helps in this work is lost to the visibility of the star.

It follows, thence, that the brightness of the sun, the stars, the planets, should diminish according to a law *much more rapid* than that of the inverse square of the distance. I say *much more rapid ;* I ought to say *extremely rapid.* In fact, from the moment when [we admit that] the recombination of the elements at the sun's surface would be capable of restoring the emitted heat, it is evident that all that emitted heat would in its turn be employed in dissociating the chemical compounds in space. That the sun should thus be continually maintained at its full energy, it would be necessary that the distance at which it is visible, far indeed from being illimitable (as it probably is) would be, on the contrary, moderate, for wherever it was still visible, there would be light *not employed in* chemical *dissociation*, and, consequently, there would be still a *possible* loss definite in amount. Nothing in the aspect of the planets and their satellites authorises, it seems to me, the admission that there is any other reduction in the brightness of light than that which results from the law of the inverse square of the distance from the central orb. We see stars whose light has taken at least three years in reaching us ; others whose light has been travelling probably thousands of years. None of this light, then, has been employed in chemical dissociation ; none of it can be restored in the way indicated by the theory (otherwise most ingenious*) of Mr. Siemens.

[The objections thus far formulated do not affect Mr. Williams's equally ingenious and more original theory : what follows does, I think.—R. A. P.]

May I be permitted, in closing this note, to return to the objection formulated by M. Faye, and to render it in some sort probable [this, considering what follows, is very good] by a numerical example ? In an important work which I am engaged upon, on the "Constitution of Stellar Space," I naturally examine the consequences which the resistance of a gas spread through space would have upon the motions of the planets. I extract from this work an example bearing on the application of analysis to the motion of our earth. According to Laplace, the diminution or increase which can be ascribed within 3,000 years to the duration of our sidereal year, taking full count of the uncertainty of the observations, would be 90 seconds at the utmost [taking more recent observations and tests of the older observations into account it can be shown that there certainly has not been a change of one full minute in the length of the year in 3,000 years.—R. A. P.] "Accepting as real a *reduction* of this amount, I examine what density a gas should have to cause such a reduction, and I show that it would suffice that one kilogramme of matter in the form of vapour should be present in 700,000,000,000 cubic mètres, in other words that the density should be 0·000,000,000,001,43 kg. [In our English way of presenting this relation we should say that 2·204·213 lb. Av. of vaporous matter would be distributed through 24,721,606,700,000 cubic feet, from which (as a standard gallon of water, specific gravity 1, contains 277·274 cubic inches, and weighs 10 lb. Av.) the careful reader can at once determine the maximum specific gravity of the interplanetary ether from the relation—

$$\text{sp. gr. required} = \frac{0{\cdot}22046217 \times 1728}{24{,}721{,}606{,}700{,}000 \times 277{\cdot}274}$$

$$= \frac{22046217 \times 1728}{2{,}472{,}160{,}670{,}000{,}000{,}000 \times 277274}$$

I leave him to work this out, but it will come out manifestly not far from

$$\frac{1800}{100{,}000{,}000{,}000 \times 300{,}000}$$

$$= {\cdot}000000000000006$$

where the density of water is 1 ; or roughly about

$${\cdot}000000000005$$

where the specific gravity of air at 39·2° F., bar. 29·9, is taken as unity.—R. A. P.] We are far, then, it will be seen, from the reduction to a 2,000th, or even to a 1,000,000th,

* Translated (by the Editor) from a note addressed to the Paris Academy of Science.

* M. Hirn's little compliment reminds me of the story of Cuvier, and the author of the "Dictionary of the Academy" :—"You ask me to give you my opinion of your definition of a crab," he wrote. "'A crab is a small red fish, which walks backwards ;' it is capital. True, a crab is not a fish, it is not red, nor necessarily small, and it does not walk backwards ; but in other respects the definition is excellent."

adopted by Mr. Siemens [also from the 100,000th suggested by Mr. Williams]. If, instead of considering solely the resistance opposed by such a gas to the motion of our planet, we carry our thoughts to the consequences which its existence would have on the existence of our own air, we find that unless we multiply our 700,000,000,000 of cubic mètres by 100,000, and reducing the density sought to 0 000,000,000,000,000,1 kg., our atmosphere would, in a few instants, be swept off (*balayée*) by the frictional action [*pression exercée en amont*] of the interplanetary atmosphere.

[What follows is curious.]

M. Faye is perfectly justified in saying that it is not this or that degree of rarefaction, but *void* (*of matter*, that is) that the astronomer requires, to ensure the stability of motion demonstrated by his analysis. This void doubtless brings to the ground the doctrine, which some pretend is so clear, which attributes all the phenomena of the universe to the movements and shocks of material atoms independent of each other. It will be necessary, one day or another, that this doctrine should yield up its life, that its defenders should resign themselves to the admission that there is something more in the world than matter in motion. In a remarkable letter to Bentley, Newton said that no man possessed of a power of forming a sound opinion in matters of philosophy could admit that between two bodies which seem to attract each other at illimitable distances, something does not exist which causes this relation; but he adds forthwith: "Is this intermediary material or immaterial? I leave this for the reader to decide." For that great genius there was certainly no uncertainty (*l'incertitude n'existait certainement*] on this last point; bu the refrained, perhaps with good reason, from proposing to his contemporaries a solution which might have seemed to them unimaginable (*insaisissable*), and which, it seems, is still so for so many minds in our own time.

DEATH-WARNING.

THE letter of Mr. Sinclair (650, p. 439) in last week's KNOWLEDGE, suggests to me to relate an even more extraordinary circumstance which occurred in my own family some years ago. The Baroness (my own mother-in-law) had a maid, a Westmoreland woman, who came from a place called Bongate, near Appleby. Subsequently to the death of her mistress she became our housekeeper, and died in the house whence I write these lines, after a continuous service of thirty-five years with mother and daughter. Before leaving her native county she had known a woman by sight, but, to the best of my belief, was not sufficiently intimate with her to speak to her. Well, one night she dreamed that this woman (of whom, be it particularly remarked, she had neither seen nor heard anything for some years), she dreamed, I say, that this woman took a piece of cord from a drawer, went into an outhouse, and hanged herself; and that, after some time, her daughter came in and cut her down. So appallingly vivid was this dream that when she came down to dress her mistress the next morning, she, in an agitated manner, told her of it, giving the details as I have given them here. Some little while afterwards a friend sent her a Westmoreland newspaper, which contained, *inter alia*, an account of the suicide of the subject of the maid's dream, and report of the inquest, whence it appeared that on the very night on which the dream occurred this woman did take a piece of rope from a drawer, did go into an outhouse and hang herself; and that her daughter did subsequently come in and cut her down! The point to be noted in this strange (but absolutely true) story is, I venture to think, the narration of the dream by G. to the Baroness, within two or three hours of its occurrence, thus precluding any *ex post facto* embellishment of it when the news of the objective suicide arrived. I inclose my name and that of the principal actors in the matter. N.

THE LIBRATION OF SENSATION.

IN my little book of "The Revised Theory of Delight, I showed, at length, that the received explanation of the phenomena of the *ocular spectra* is full of discrepancies and insufficient. And in that work and my previous lectures on Light] I endeavoured to explain my hypothesis of the Libration of Sensation, or that tendency of the nervous reaction from an initial sensation, to one of an opposite kind, and in the ratio in which that initial sensation was a departure from the *mean* state, or state of repose of the nervous system. This law not only holds good with respect to the sense of sight, but to the whole human system, and thus we find that the great law of compensation, which holds in the Kosmos, also obtains in the human constitution—viz., that whatever aberration takes place in *excess* of a mean state must be compensated by an equal and opposite one in *defect* of that state.

The fact that the sentient eye is the only "colour box," and that external to this there is nothing but mechanical vibrations, is not sufficiently present to the minds of most persons to prevent them from reasoning as if colour were a property of the vibrations themselves. This is the case with reference to the phenomena of the *ocular spectra*, which are regarded as external effects instead of, as they are, internal phenomena of the sentient being, due to the reactions of the nervous system, and which may be experienced after an initial sensation, though the eye be closed against all external vibratory action. An initial impression of a black spot in a white field is succeeded by a sensation of a white spot in a black field. An impression of a dark colour in a white field by its light, opposite and complementary colour, in a black field, and *vice versâ*.

We find, then, that similar changes in colour to those produced by the cooling of beads, alluded to by your correspondent in last week's issue, also occur in the retina by the decadence of an initial sensation, for the complementary spectra are entirely subjective phenomena. After a very strong initial sensation of colour, the sequent spectra endure a sufficient length of time to enable any one to experiment with them. For instance, after being dazed by the sun, the spectrum of any one of the sequent sensations or spectra, say, dark red on a white field, will become light green in a dark field, and will become dark red again in a light field. Here, then, the vibratory reaction is changed within the nervous system itself, so as to produce sensations of different colours. In consequence of these and other investigations I came to a conclusion very similar to that of your correspondent, which I expressed in a letter to the editor of the *Builder*, April 23, 1881, in the following words:—"It is curious that, with the endeavour to establish the close analogy between light and sound, that a body appearing of a certain colour has never been accounted for, as we account for a musical string responding to the note to which it has been attuned, and to that vibration only. In like manner, bodies only emit that colour vibration to which their molecular constitution is attuned." W. CAVE THOMAS.

XUM

Reviews.

THE FARM IN THE KAROO.*

OUR object being to disseminate knowledge, we cannot fail to recommend to our readers the book before us, for although written ostensibly for boys, it is full of information about South Africa, its physical features, natural productions, its people, both British, Dutch, and native, with their mode of life and various industries, such as ostrich-farming, the mode of inoculating cattle against cattle plague, &c., &c., all of which will be read with pleasure by those desirous of knowing something of life at "the Cape;" nor is the antiquary and anthropologist forgotten, as the following quotation, descriptive of the cave paintings of the Bushmen, will show :—

A long walk brought them at last to the cave, or series of small cavities in the mountain side, and here on the rocks had been painted by the Bushmen various figures of animals.

"Those fellows evinced a wonderful talent for drawing," exclaimed Marston. "Just look at that pig. I couldn't have sketched it better myself. A blue pig and a red hippopotamus. And what is this figure? Something of the deer species."

"With only one horn!" said Fred. "It reminds one of the unicorn."

"I always thought that that fighting animal was a myth," rejoined Marston; "but there he is, sure enough."

"Yes; that figure has been often put forward as the original of the unicorn; but my father considers it is intended for a gemsbock, an animal which has very straight horns, and the Bushmen, taking merely the profile, have delineated but one," said George.

"What are they supposed to have used for paint?" asked Charley.

"For the red, no doubt they sometimes used the red clay which the Kaffirs rub on their bodies and blankets; but they also used brown cubes of iron pyrites, or peroxide of iron. I don't know what they made use of for the blue; probably copper ore."

"Look here!" exclaimed Marston. "What are these?"

"Those are arrow-heads," said Fred. "I am so glad you saw them. This has evidently been one of their workshops, for here they are in all stages of manufacture."

"And," exclaimed Frank, "just look at that great lump of black basaltic rock. It must have been brought from a long distance, for there are no rocks like it in this neighbourhood. I have often found these stone knives and arrow points on the plains, and have a few very good ones at home."

"I must take some of these with me," said Fred, putting several into his pocket. "May I have them?"

"Take as many as you like," George replied, "for these things are not accounted treasures in this country. I took some down to Dr. Atherstone, of Grahamstown, who is a very great connoisseur of such things, and is also an excellent geologist, to whose opinion we always defer. When any stone or metal new to us is found we send it to him. It was he who pronounced a stone from the Transvaal to be a diamond, and thus opened up the diamond fields. Before that time the most brilliant stones had been passed by with perhaps a mere remark as to their being prettier crystals than those found in the old colony."

"What crystals, then, do you find here?" said Marston.

"Common quartz, and sometimes jasper, I believe. My father once, while hunting on the banks of the Vaal River, picked up a gem that would have rivalled the 'Star of South Africa.' He thought it a piece of quartz of a very beautiful shape, and much more bright than usual, so he carried it in his waistcoat pocket for some days; but he also carried his gun-caps there, and whenever he put his fingers in for a cap the stone came in his way; so one day, as he was riding hard after a herd of gnoos, he was so annoyed by it that he threw it into a bush, not dreaming that his bright stone might be worth a king's ransom."

"What a go!" said Marston; "didn't he ever try to find it again?"

"Yes, he did, for he thought he could remember the very spot; and some time after all the stir was made about the diamonds, he went up to see the diggings, and hunted about, but to no purpose."

"How provoking!" said Marston. "It would have been glorious to find it after all that time."

"Is not this a grinding apparatus?" inquired Charley; "I have seen round stones like it in collections of stone implements at home."

"A muller; so it is!" answered George; "and, you see, here is full evidence of what I told you, as to what the *little folk* used for paint. Cubes of peroxide of iron, some of them still whole, others broken and ground up. This rock seems to have been slightly hollowed so as to hold water. Generally speaking, the grinding-stones are quite flat. The Hottentots still use them. They grind the coarse salt with them, also coffee, and even their snuff. No doubt Kaatje has one with her, upon which she grinds our coffee after having roasted it."

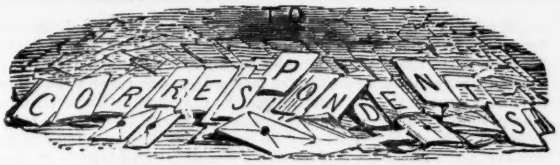
We believe that all who read will see at once that the author writes from personal knowledge of the country, and indeed, she informs us in the preface that she has resided for more than a quarter of a century in the colony, and she very evidently has not put her eyes in her pocket during that time. She also vouches for the truth of the wonderful adventures with snakes and wild beasts which she relates, which will certainly add zest to their perusal.

* *The Farm in the Karoo.* By Mrs. Carey-Hobson.

New South Welsh Coal.—The output of coal in New South Wales in 1880 reached 1,466,180 tons. In 1830 the amount of coal raised in the colony was, in round figures, 40,000 tons; in 1840, 30,256 tons; in 1850, 71,216 tons; in 1860, 368,862 tons; in 1870, 868,564 tons; and in 1880 as above, showing a very great expansion during the last 30 years.

Anglo-American Brush Electric Light Corporation.—The following is a copy of a resolution passed by the Board of the above Company on Nov. 29:—"Resolved, that a call of £3 per share be made on the £4 paid shares of the Corporation, to meet the cost of extension of works and machinery, and manufacture of stock, the same to be payable in instalments of £1 each on Jan. 1, Feb. 1, and March 1, 1883."

Birds and Telegraph Wires.—At a recent meeting of the Electrotechnic Society of Berlin, Herr Massmann read a paper on some observations which he had made on the Imperial telegraph lines at the instance of the Secretary of the Post Office. He found that in districts where there are no trees, the smaller birds of prey, such as crows and magpies, are very fond of roosting on telegraph poles, while sparrows, starlings, and swallows frequently alight on them in great numbers. This leads to a fouling of the wires with excrement until they look as if they were plastered. The soil has, however, no damaging effect, as the rain washes it off, unless, indeed, the acid excrement tends to the decay of the wooden poles. Swallows like to build under the eaves where wires run into telegraph offices, and sometimes cause an "earth" contact. Contacts between wire and wire are frequently caused by large birds, such as bustards, storks, swans, and wild ducks. They cause the wires to swing, and sometimes to break. Accidents of this kind were frequent when the wires ran by high-roads, along which young geese were driven to their pastures. Smaller birds, even partridges, are generally killed by the shock of striking the wires. They do not cause much damage to the lines. Holes are often pecked through the poles by woodpeckers (the *Picas martius*, or black woodpecker, the *P. viridis*, or green woodpecker, and the *P. major*, or piebald woodpecker). These birds spare no kind of wood, unprepared pine and oak poles, as well as poles treated with sulphate of copper, chloride of zinc, or sublimate of mercury. Some even state that they will attack creosoted poles. The theory that the birds mistake the vibration of the wires in the pole for insects humming is doubted by Herr Massmann, who declares that they often find insects in the dry poles.



Letters to the Editor.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO, DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

All Remittances, Cheques, and Post Office Orders should be made payable to MESSRS. WYMAN & SONS.

The Editor is not responsible for the opinions of correspondents.

NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

EARTHQUAKES IN THE BRITISH ISLES.

[652]—Permit me to mention one or two earthquakes which are omitted in your articles.

In 1134 an earthquake occurred, and "flames of fire burst out of certain rifts of the earth with great violence."

1249-50. A shock overthrew St. Michael's-on-the-Hill, without Glastonbury, and did much damage at St. Alban's. It was also felt in Somersetshire. At the same time, part of the town of Winchelsea was swallowed up by the sea, and great damage was done in the fens of Lincolnshire.

In 1328, on Nov. 14, occurred "the greatest earthquake ever felt in England." This remarkable statement rests solely on the authority of Dr. Bascome, in whose work ("History of Epidemic Pestilences") there is unfortunately no reference to his source of information.

1350. In Ireland, according to Short, an earthquake caused the demolition of cities, and great "loss of people."

1734. In August, 100 houses and five churches were destroyed in Ireland.

1749. A shock occurred at Leadhills (Scotland), which caused people to run out of their houses. This happened about the very time that Lima was destroyed.

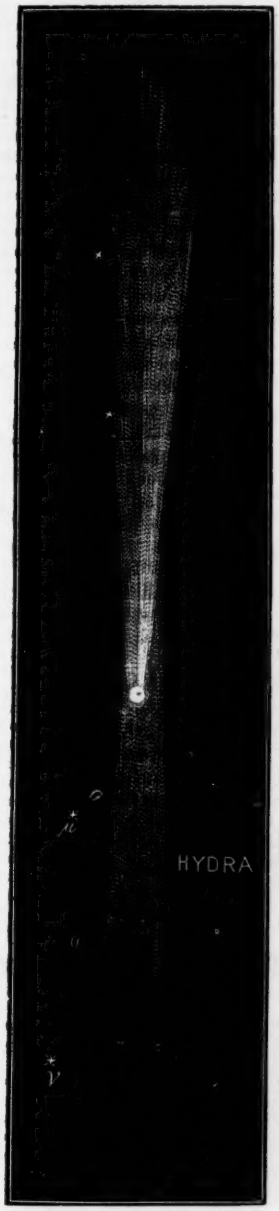
1750. London was shaken by two earthquakes in this year. The first occurred on Feb. 8, and, besides causing great alarm, overthrew a chimney in Leadenhall-street, another in Billiter-square, part of a house near Horsleydown, and a slaughter-house in Southwark. The second took place on March 8, and, though more violent and of longer continuance than the other, did little damage beyond breaking the chinaware in the shops, and bringing down some of the stones from the towers (then nearly erected) of Westminster Abbey. This latter shock was felt at Cheshunt, Hertford, Ware, Copthall, and Beckenham. It was these two shocks, following so closely in succession, that caused the panic about a month later (April 5), when many people passed the night in boats and carriages. A third shock was felt at Nottingham, Retford, Scopton, Tuxford, and elsewhere, on Aug. 23.

Allow me, in conclusion, to notice a slight anachronism in the first paper (p. 340). An earthquake is mentioned as having caused some damage on the banks of the Thames in 1247, apparently on the authority of Matthew Paris, and in the following paragraph we are told that, in 1248, "the western parts of England were shaken with an energy far exceeding anything which has been known in recent times," the shock doing serious injury at Bath and Wells. In reality, it was the former of these shocks, that of 1247, that was the more serious. Short calls it "one of the greatest earthquakes ever felt in England," and adds that it was most severe about London and Thames side. How widespread it really was, is now hard to determine. According to the Annals of Multifernan, the shock was felt "throughout the whole west." That might mean anything, but Hanmer tells us that it is the "west of the world" that is meant. Telcon (Ware's Annals), on the other hand, says that Ireland "and the rest of the world" was affected, while Horilegus asserts that it was only England. From the reference made by Short to the earthquake of 1248, it seems to have been a local one confined to the neighbourhood of Bath and Wells.—Yours truly,

J. A. WESTWOOD OLIVER.

THE COMET.

[653]—I enclose a sketch of the comet as I observed it with a pair of good field-glasses on Oct. 24 at 4.30 a.m. (local) at sea, in lat. 32° 22′ N., long. 31° 34′ W. The comet, on this occasion, showed an appearance which I had not noticed before. It appeared to be enveloped in a cone of faint light, which at one end merged into the tail, and at the other extended about half the length of the tail beyond the nucleus, and gradually faded away. It seemed as though particles were being actually swept from the tail by a resisting medium. The sky was very clear at the time, and there



were no signs of approaching daylight. The appearance was confirmed by Dr. Copeland, of Dunecht, and others. The folded-over appearance of the tail was also very marked, but this had been noticed for some days. The southern edge of the tail was more clearly defined than the northern. The comet was then near the stars μ and ν Hydræ. The following morning the moon was above the horizon till daylight, so the appearance was lost.

Transit of Venus Expedition, J. H. THOMSON, Lt. R.A.
Barbadoes, Oct. 30, 1882.

XUM

CORSET WEARING.

[654]—Permit me to make one or two further remarks on corset wearing and figure training, in continuation of my former letter, No. 591, which has been commented upon by Dr. Leigh in letter No. 620.

I do not think that the *total* breathing space is diminished, providing the lacing is commenced early enough and continued carefully and progressively, so as to *develop* the upper and middle parts of the chest. *In point of argument* I do not see the great difference between Dr. Leigh's ideas that "if a woman, long used to the support of stays, leave off wearing them, she will doubtless feel their loss"; and, "but if unused to such artificial support, the wearing them will add to their ills, and produce ailments she never experienced before." I should condemn either way, for one is as bad as the other. The great thing I contend for, and what I feel is really the pith of the whole matter, is to begin at a proper age to apply the corset and continue it regularly and progressively until the figure is formed; there will be no contra indication to its wear afterwards; in this case there is never any reduction of figure, because there never has been any overgrowth, hence actually there must be a development. Neither is there in this case any compression; the corset simply fits the waist, just as every boot or glove ought to fit the foot and hand. Dr. Leigh says the figure is rendered inelegant rather than elegant, and he cites as an example the undraped figure of a modern corset-wearing lady, and compares it with the Venus of the Art Galleries. Let me, on the other hand, ask him to imagine what is far more feasible, a draped Venus, even of Milo. [I doubt very much whether the so-called Venus of Milo is a Venus at all; the theory that the latter is a Victory seems much better.—Ed.] He will find that he has got a dowdy, with a vengeance.

Alfred Chadwick, M.D.

[The rest of our correspondent's letter, relating to the question of taste, we have been obliged to omit for want of space. Noting that the so-called Venus of Milo was almost certainly a Victory, were any of the most celebrated Venuses of antiquity intended to represent girlish beauty? Again, would the draped Diana of the Louvre be quite correctly described as a dowdy?—Ed.]

USE OF THE TEAZEL.

[655]—Mr. Allen, in his most interesting article on the teasel, says the plant is used by man for "fulling purposes." Now, fulling is a cleansing and shrinking process which every woollen manufacturer understands, wherein the cloth is continuously run between squeezing rollers, and is, during the process, saturated more or less with soap. It is the same principle as washing flannel before using—viz., to shrink it. It is often called milling, and upon the "mill ground" which the cloth obtains during the process depends the fatness and beauty which the teasel makes. The cloth is scratched or brushed by the teazel, always from one end, until sufficiently "roughed," as it is called. The wool curls under the teazel in the same manner that our own hair curls when well brushed. It is a somewhat singular fact that the wild teasel has no hook, but only gains the hook when cultivated. The topmost teazels of the plant are called "kings," those next "queens," the next "middlings," and the rest "smalls" or "buttons."

A Woollen Manufacturer.

Answers to Correspondents.

This section is limited to one column as the maximum. Only a small proportion of the letters received can, therefore, be answered here. Many not answered may nevertheless be noted and acted upon. Letters raising religious, political, or personal questions, asking for text-book information, proposing class-room problems for solution, and so forth, pass at once to a receptacle specially provided for them. A stern and inflexible censor has been specially appointed to stand between a too-yielding Editor and those who thus unreasonably claim his attention and space which should be otherwise occupied.
No letters answered through the post.

R. Phillips. Now, if we were *all* so positive! Were I but as positive in thinking you profoundly in error!—B. Davis. Heat and light travel same rate; no connection between radiation and conduction.—J. W. Thanks.—M. R. Editor's best brain waves exerted to clear off arrears.—R. B. G. Explanation impossible; consider sun's size and distance.—E. Simpson.—Too long for answer here; but surface of flowing water is not necessarily horizontal.—R. D. Napier. That seems to explain what you saw.—W. L. If you know C.G. of cone or pyramid, there should be no difficulty in finding C.G. of frustum, considering that the fr. is the difference between two cones or two pyramids.—H. A. B. Due to difference between mean time and apparent solar time.—Vagie Simons. Word "stand" may be used in either of two senses, one correct the other not, in reference to one who walks.—E. A. Smith. Do not know where such transfer slides obtainable.—Barnum. Thanks; overcrowded.—P. Q. R. That way of describing size of comet is, as you say, quite absurd.—J. Jackson. Noted. Can give no replies about trade articles.—J. W. B. Quite correct; equivalent in absorptive action.—G. J. O. End of Universe of Stars.—P. C. G. Yes; that is the neatest form of the proof; but then it was just that form questioner could not follow; so we gave a fuller one.—J. S. Harris. It would make no difference; checked motion means heat, whatever changes may take place. On other point, it seems unlikely.—D. Ramsay. See notice about those star maps.—W. A. S. Wants a column; space wanted.—Newton Crosland. "Fatuous fallacies of false philosophy!" But if "Darwinian theories swept out of the minds of all intelligent persons," why not be content?—S. C. A series of volumes could be formed out of the discussion whether *Vis Viva* rightly applied to product of mass and square of velocity. It is only a name, anyway; and means only that product.—Quzum. Wants an article or a series. Think of our difficulties, and if these cause necessary omissions, X Quzum.—H. Alexander. Pardon me, it *would* do harm to insert your guesses as forecasts.—F. J. Butt. Thanks.—Experimentalist wants to know how a wooden substance may be reduced to a fibrous pulp.—Gradatim. (1) If you cannot find the proof you want in Airy's Tract on "Precession and Nutation," you are studying a subject a little beyond you. Read articles 28, 29, 30, and 31, and interpret the expression added to I. in 31, as the second term of the expression for the precession is interpreted in 29; and then ask whether you should have sent me again to my bookshelves to hunt out the passage. (2) When eccentricity moderate, there is no marked difference wherever the perihelion may be round orbit.—W. R. Davies. I have no back numbers.—Jas. Grundy, Indicus. Noted and referred. F. C., B. Webber. Quite hopeless for us to try to find space.—X. Z. Sir G. Airy at Greenwich, and Professor Piazzi Smyth at Edinburgh, both proved that.—W. K. Gilmore. Fatally attractive theory!—W. M. B. Beaumont. Thanks.—M. S. Many thanks. Will try to find room for your interesting diary notes. C. H. Romanes. Have endeavoured to obtain a satisfactory explanation of the flap experiments, but have not succeeded. One correspondent (private) has noted rather different results. The subject is hardly suited to our columns.—E. R. M. Fear cannot tell you where to get books for Hamiltonian method. I got all I wanted in Holywell-street.—W. J. Thanks.—M. B. Alder. Many thanks, but our "Jorkins" already appointed.—J. A. J. Thanks. Questions about books cannot be inserted. They lead to multitudinous replies, and some gratis advertising.—R. A. G. From improved orbit earth certainly did not pass through comet's tail.—Cosmos. Glasgow, Sunday, December 10; subject, "Birth and Death of Worlds." Bind star maps as may be preferred.—R. Thomson. The centrifugal and centripetal tendencies compensate each other while the orbit is elliptical. When frictional resistance comes in there is no such compensation, whatever the form of the orbit.—L. R. Shorter. Fear the computation useless, the accounts on which it is based being quite inexact.—A Disappointed One. Wanting to please all—there's the "reason why." Won't do so any more, or make promises which others prevent me from fulfilling.—X. You might submit those questions to Professor Owen.—Jane Carr. If that is right, all the leaders of modern biological science are wrong.—David Denney. How can a book be sacred *per se*? Certain persons *must* decide what books are sacred. Dear me: if you were right, how much labour I might have been saved at King's College in learning what are the specific decisions by which this or that book took its place, or was refused a place, as a sacred one! As for "germs of truth," there are germs of truth in a good many things, but that don't make them all revelations.

ELECTRICAL.

W. P. See "Gossip," Knowledge, No. 57.—A. E. Neal. 1. Not without a deal of calculation, and, even then, the result would be most unsatisfactory. 2. A medical coil would be of no use to produce an electric light. 3. The hole in the covering of the carbon-manganese mixture in the Leclanché cell is to allow any gases evolved in the porous pot to escape.—Alpha. Will try to find room for a short article on the subject soon.—J. J. L. 1. The current depends so much on the quality of the iron employed and on other kindred points, that it is unsafe to predict a result. I purpose saying a little on the subject in the articles on "Measurement." Each of the plates forming the field magnets takes about ⅝ of a pound of wire. 2. The resistance of the armature is not necessarily 7 Ohms unless the same size wire is used. Of course, you can use

thicker wire, but with the same core you would have fewer turns, and consequently less E.M.F. On the other hand, an increase in the size of the armature would necessitate a proportionate enlargement of all parts. It is evident that if the resistance is reduced (the E.M.F. being kept constant) the current-strength must be increased. 3. Not efficiently or economically. The armature should be wound in sections to produce a current of such proportions. Have you the convenience for making a Gramme?—W. G. Woolcombe. 1. The length depends upon the kind of spark you require. About 5 in. would be a useful length. 2. The bobbin ends 3 in. in diameter. 3. Core (a bundle of soft iron wire), half-an-inch in diameter. 4. Paper, well gummed. 5. Boxwood would answer very well. 6. Any good text-book on electricity.

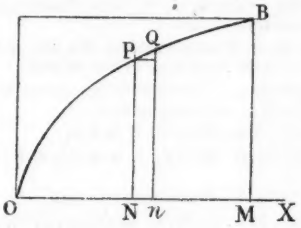
Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

No. XIV.

HERE are a few simple examples of the process of integration as explained in the last lesson :—

O P B is a parabola, O X its axis, the equation to the parabola being $y^2 = mx$. To determine the area O B M, when O M = b.



Draw ordinates P N, Q n close together. Let O N $= x$, N $n = \Delta x$. Rectangle P $n = y\,\Delta x$. Then, since the area is the sum of all such rectangles as P n between O and B M when they are made indefinitely thin, we have area O B M $= \int_0^b y\,dx$

$$= \int_0^b \sqrt{mx}\,dx$$

We have to find out what expression that is which has $\sqrt{mx}$ for its differential coefficient. We may write this $\sqrt{m} \cdot x^{\frac{1}{2}}$, and we know that in differentiating x raised to any power, the index sinks by unity and appears also as a factor in the differential coefficient. Therefore $x^{\frac{1}{2}}$ must be the differential coefficient of $x^{\frac{3}{2}}$ multiplied by a factor which is altered into unity when multiplied by $\frac{3}{2}$: that is to say, the factor must be $\frac{2}{3}$. Hence

$$\int \sqrt{mx}\,dx = \sqrt{m} \cdot \tfrac{2}{3} x^{\frac{3}{2}} + \text{a constant.}$$

(The student should differentiate this expression to make sure that its differential coefficient is $\sqrt{mx}$). Giving to x first the value b, and then the value 0, we find

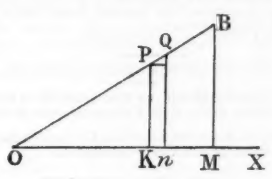
$$\text{area O B M} = \frac{2\sqrt{m}b^{\frac{3}{2}}}{3} + C - (0 + C) = \frac{2\sqrt{m}b^{\frac{3}{2}}}{3}$$

or, since O M $= b$, and B M $= \sqrt{mb}$; area O B M $= \frac{2}{3}$ rect. B O.

Of course, there is no occasion in practice for all that has been here written out.

Take another case, to show how such problems are dealt with :—

Required the volume of the right cone produced by the revolution of right triangle O B M around O M, O M $= a$, B M $= b$.



Put O K $= x$, K $n = \Delta x$. Then P K, the volume produced by the revolution of rect. P n around O X $= \pi$ (P K)^2. K n

$$= \pi\left(\frac{b}{a}\right)^2 x^2 \Delta x$$

$$\therefore \text{required volume} = \frac{\pi b^2}{a^2}\int_0^a x^2 dx$$

Now obviously the expression of which x^2 is the differential coefficient is $\frac{1}{3}x^3 + \text{const.}$ (Differentiate, and see.) Hence

$$\text{volume of cone} = \frac{\pi b^2}{3a^2} \cdot a^3 = \frac{1}{3}\pi a b^2$$

uppose the following problem set :—

In the cone last considered the density of successive thin circles such as the one formed by the revolution of P n, varies as the square of O K; required the mass of the cone formed by the revolution of O B M.

Proceeding as before, we find mass produced by revolution of P n around O X $= \pi\left(\frac{b}{a}\right)^2 x^2 \Delta x \times \rho x^2$, where ρ is the density at a unit of distance from O along O X. Hence in this case

$$\text{Mass reg.} = \pi\left(\frac{b}{a}\right)^2 \rho \int_0^a x^4\,dx = \frac{\pi\rho}{5}\left(\frac{b}{a}\right)^2 a^5 = \frac{1}{5}\pi\rho a^3 b^2$$

These examples are only intended to give an idea of the use of integration; we shall consider later the principles by which areas, volumes, masses, lengths of arcs, &c., are determined. Let it suffice, in this preliminary view, to note how problems which, dealt with geometrically, would require more or less of skill or artifice, can be dealt with easily and systematically by integration.

Our Whist Column.

By "Five of Clubs."

PLAY FOURTH HAND.

(*Continued from page 424.*)

FIRST, when late in the game you have the King card and a small one, and the play shows that, though led by your left-hand adversary, the suit is your partner's, the remaining cards in your hands being all losing ones. If in this case you let your partner's card win, you are obliged to win the next trick in the suit and lead a losing card. But if you take the trick with the King card and lead the small one, you are leading through strength up to weakness, and your partner may finesse deeply, and perhaps make all the tricks in the suit. Usually the case occurs in the first round of the suit; but it may also happen in the second. Thus, suppose a suit originally led by your partner from Knave, Nine, and three small ones, you holding King, Queen, and one small one, play the Queen, and fourth in hand takes the trick with Ace. Later on (trumps being out) the latter—your adversary on the left—leads a small one (having held originally Ace, Ten, Eight, and a small one). Your partner plays the Seven, third hand a loose card. If you play the small one, and your partner leads the suit again, your King makes, but you have to lead a losing card, and the rest of the tricks probably go to the adversaries. But if you take the trick with your King and lead the small one, your partner makes three more tricks in the suit.

The second case is one in which you must let the adversaries take the trick. When you hold the best, fourth best, and small card of a suit, and a second best is led by your left-hand adversary, who also holds the third and fifth best, you must pass the trick. If you win it you must lead through his tenace and lose the other two tricks; if you pass it, he must lead up to your tenace, and you win the other two tricks.

When, fourth in hand, you have won a trick very easily, it is often good to return your enemy's suit; for the original leader must then play as if third in hand, hoping for no support from his partner. In trumps this is not safe, however. Even if third hand is really as weak as he seems, you play the enemy's game by continuing the suit. But in trumps it is always possible that a winning card may be kept back to support more effectively later a strong game of the enemy's.

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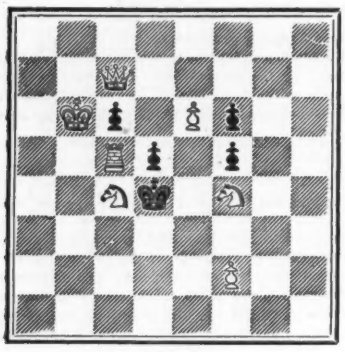
Our Chess Column.

By Mephisto.

PROBLEM No. 63.

By G. Woodcock.

Black.



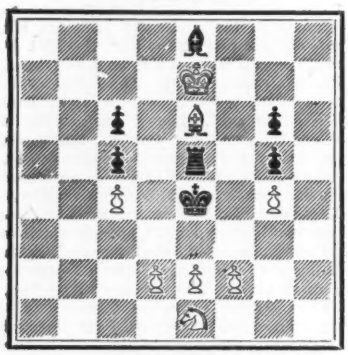
White.

White to play and mate in three moves.

PROBLEM No. 64.

By A. B. Palmer.

Black.



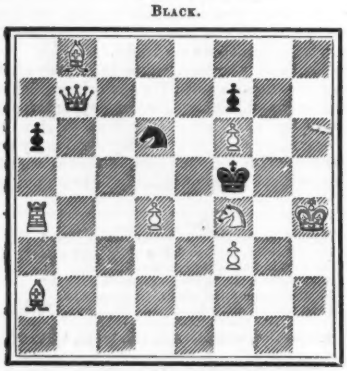
White.

White to play and mate in six moves.

PROBLEM No. 65.

By G. H. T.

Black.



White.

White to play and mate in two moves.

SOLUTION.

Reprint Problem, p. 410—

1. Kt to KB5 (ch) / K to Kt5
2. Q to B sq / Anything
3. Q to R3 (ch) / K takes Q
4. Kt to B2 (ch) / Mate.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Notice.—We cannot guarantee a reply in the same week's issue of Knowledge for letters received later than Monday morning.

W. H. P.—1. Q to R. 2, and mate in two moves follows.

A. Cyril Pearson.—Thanks for problem, which is welcome. We quite agree with your criticism of the two problems; nevertheless we were justified in publishing them. We like to publish easy problems. Our intention, however, was to publish each of these two problems in harmonious connection with more difficult compositions; but owing to circumstances over which we had no control, the two problems appeared too prominently in our columns. As to the idea in Eichstadt's problem not being good, we certainly differ from you; pray look at Problem No. 54, in No. 47 of Knowledge, and give us your opinion of it.

J. Hughes.—Problem received; will be examined.

F. J. C., John O'Keeffe, C. T. Grey, Francis J. Drake, John W. Fowler.—Manuscripts returned.

R. J. P., W. H. B. H.—In Problem No. 60, if 1. Q to Kt3 (ch) 1. P to B5, and there is no mate in two moves.

T. Steele Sheldon, S. Basson Lello, Tyro.—If 1. Kt to QKt6, 1. P to Kt6, there is no mate possible.

Old Meldrum.—How about 3. K to B sq.

A. McD.—If 1. Kt. takes P., 1. K to B5, 2. K. takes P., 2. P. to Kt6.

C. H. Brockelbank.—Variations correct.

W. C. Thomas, J. V. B., W. G. Reynolds, R. T., A Novice.—Solutions incorrect.

R. Sargeant, jun.—1. P to Kt6 and no mate possible.

Correct solutions of Problem No. 60 received from Herbert Jacobs, Leonard P. Rees, Francis J. Drake, John Blain. No. 61.—S. Bassan Lello, Herbert Jacobs, T. Steele Sheldon, Berrow, Francis J. Drake, H. Seward, R. J. P., T. T. Dorrington, T. S. L., Geo. H. Bonner, John Simpson, A Novice, J. P. No. 62.—John Simpson, R. J. P., Berrow, T. T. Dorrington, H. Seward, S. Bassan Lello, John Watson. Reprint.—Herbert Jacobs.

W. H. B. H., Tyro, Old Meldrum.—Solution of No. 61 incorrect.

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